



# Toward Requirements for a Web-based Icing Training Program for Flight Dispatchers

Ellen J. Bass and Carolyn J. Quil

**SCHOOL OF  
ENGINEERING  
& APPLIED SCIENCE**

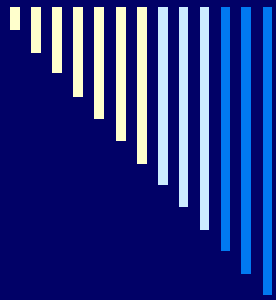


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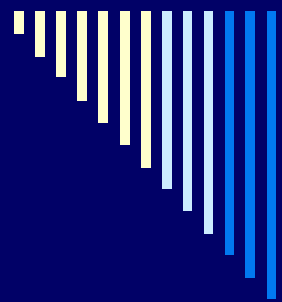
Sponsor: Icing Branch at NASA Glenn Research Center  
Technical Monitor: Andrew Reehorst





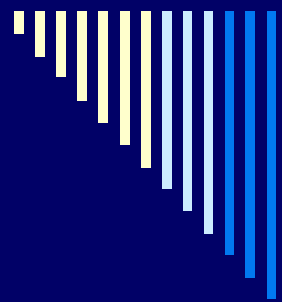
# Outline

- Background about Flight Dispatchers
- Project Goals
- Findings
- Recommendations



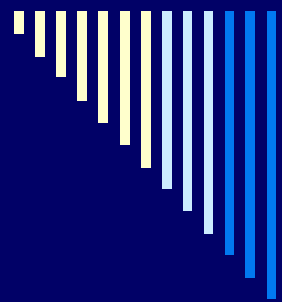
# What are Flight Dispatchers?

- Licensed airmen certified by the FAA
- Joint responsibility with the pilot-in-command (PIC) for the safety and operations of the flight



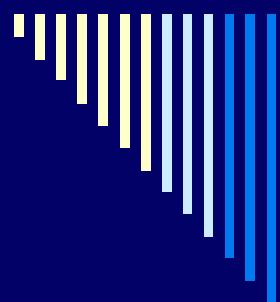
# Flight Dispatchers' Responsibilities

- Authorize, regulate and control commercial airline flights according to regulations to expedite and ensure safety of flight.
- Prepares and signs the dispatch release
  - Analyzes meteorological information: potential hazards to safety of flight.
  - Select the route of flight: safety, legality, passenger comfort, schedule, economy.
  - Computes fuel required: type of aircraft, distance of flight, maintenance limitations, weather conditions and minimum fuel requirements.
  - Prepares flight plans and weather briefings.



## Flight Dispatchers' Responsibilities (cont.)

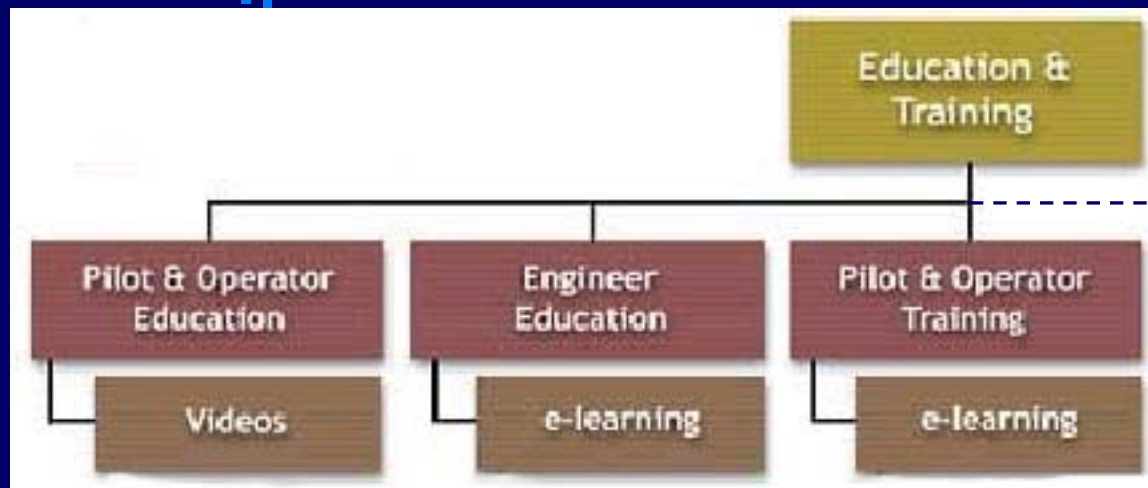
- ❑ Delays or cancels flights if unsafe
- ❑ Monitors progress of flight.
- ❑ Updates PIC of significant changes
- ❑ Originates and disseminates flight information to others including stations and reservations.
  - This is the source of information provided to the traveling public.



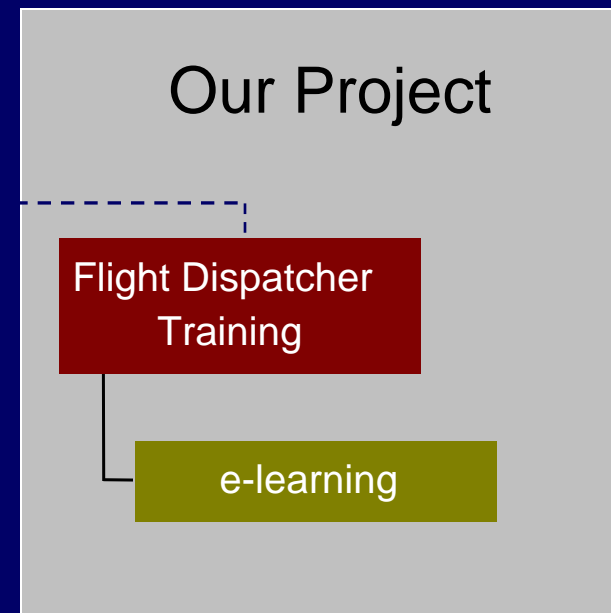
## Icing Constraints on Dispatch

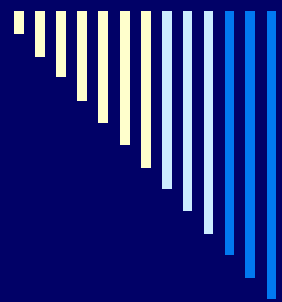
- When icing conditions are expected or currently exist that might adversely affect the safety of the flight.
- When frost, ice, or snow may reasonably be expected to adhere to the aircraft, unless the dispatch, release, and takeoff comply with approved ground deicing/anti-icing program.

# Expansion of the Icing Branch's Training Capabilities



Current  
Training  
Capabilities

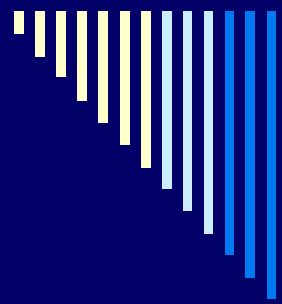




# Goals for Analysis

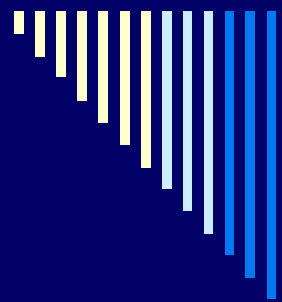
- ❑ Understand FD judgment and decision making as impacted by icing concerns
- ❑ Understand the regulations impacting training practices
- ❑ Review existing operational materials and tools
  - Identify problems with understanding icing conditions and what to do about them
- ❑ Identify barriers to web-based training
- ❑ Identify pedagogical strategies to be used in web-based training





# FD judgment and decision making: Ground deicing/anti-icing

- The use of holdover times
- Communications procedures;
- Aircraft surface contamination and critical area identification, and how contamination adversely affects aircraft performance and flight characteristics;
- Types and characteristics of deicing/anti-icing fluids;
- Cold weather preflight inspection procedures; and
- Techniques for recognizing contamination on the aircraft.



## FD judgment and decision making: Other preflight decisions

- Flight cancellation,
- Flight plan routing based on aircraft equipment and weather,
- Alternate airport selection,
- Fuel load planning,
- Weight restriction considerations,
- Updating flight enroute (flight following)

# FD judgment and decision making: Minimum equipment lists (MELs)

**Canadair Regional Jet - Minimum Equipment List**

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**System 30: ICE & RAIN PROTECTION**

October 9, 2001 Revision: 18

System & Sequence Numbers	Item	1	2	Number Installed	3 Number Required for Dispatch
30 ICE & RAIN PROTECTION 12-01	Wing anti-ice Modulating and SOV	C	2	0	<div style="border: 1px solid black; padding: 5px;"><b>4 Remarks or Exceptions</b> (M) Both may be inoperative provided: a) Valves are secured CLOSED, b) Operations are not conducted in known or forecast icing conditions, and c) Both Ice Detection Systems are operative.</div>

**PLACARD**

Place an inoperative placard with the System & Sequence Number and DMI number on the ANTI-ICE panel.

**MAINTENANCE (M)**

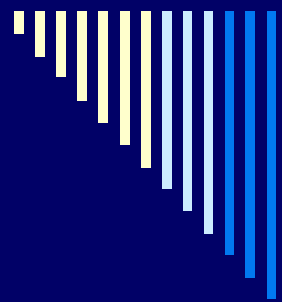
A. For inoperative wing anti-ice modulating and SOVs, do as follows:  
(1) Do the deactivation of the modulating and shutoff valve (refer to the AMM TASK 30-12-00-040-804).

**OPERATIONS (O)**

Not Required

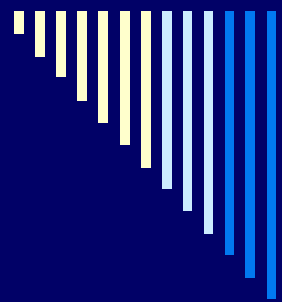
Shut off valve

Operations are not conducted in  
known or forecast icing conditions



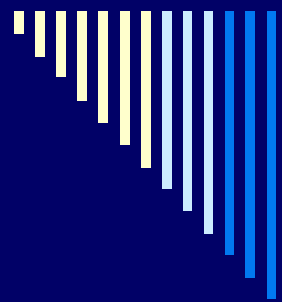
## FD judgment and decision making: Minimum equipment lists (MELs)

- What is wrong with the aircraft (if anything)?
- What types of icing conditions must this aircraft avoid?
- Along what route and at what altitude can this flight safely be routed?
- If the altitude is restricted, what related changes must be made?



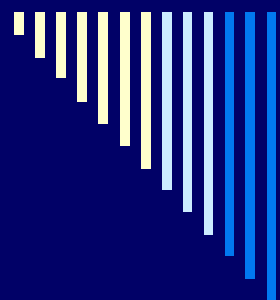
## FD judgment and decision making: Long time horizon

- Period from before the scheduled departure time to the scheduled arrival time (with cushions on either end for contingency planning).
- Downstream flights
- For the last flight of the day, flight dispatchers must even consider the next day's weather



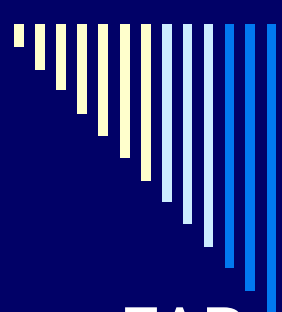
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# Legal Training Requirements

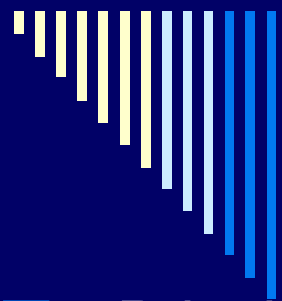
- ☐ Initial certification
- ☐ New hire
- ☐ Recurrent



# Initial certification: 200 hours (6 weeks) with 13 required topic areas

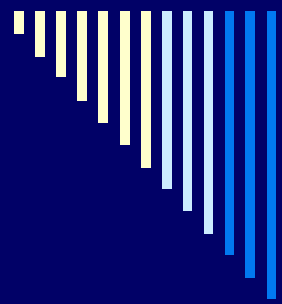
- FARs that relate to ATP privileges, limitations, and flight operations
- Meteorology
- General system of weather & NOTAM collection, dissemination, interpretation, use
- Interpretation & use of weather charts, maps, forecasts, sequence reports, abbreviations, & symbols
- NWS functions as they pertain to operations in the National Airspace System
- Windshear & microburst awareness, identification, & avoidance
- Principles of air navigation under IMC in the National Airspace System





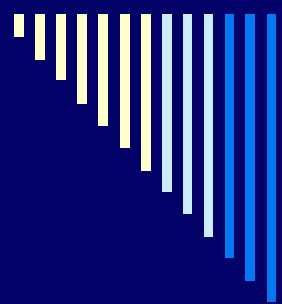
## Initial certification: 13 required topic areas (cont)

- ❑ Principles of air navigation under IMC in the National Airspace System;
- ❑ ATC procedures & pilot responsibilities as they relate to enroute operations, terminal area & radar operations, & instrument departure & approach procedures;
- ❑ Aircraft loading, weight & balance, use of charts, graphs, tables, formulas, & computations, & their effect on aircraft performance;
- ❑ Aerodynamics relating to an aircraft's flight characteristics & performance in normal and abnormal flight regimes;
- ❑ Human factors;
- ❑ Aeronautical decision making and judgment;
- ❑ Crew resource management



# Initial certification: Meteorology - Basic Weather Studies (15 topics)

- (1) The earth's motion and its effects on weather.
- (2) Regional weather types, characteristics, and structures, or combinations thereof: (a) Maritime. (b) Continental. (c) Polar. (d) Tropical.
- (3) Local weather types, characteristics, and structures or combinations thereof: (a) Coastal. (b) Mountainous. (c) Island. (d) Plains.
- (4) The atmosphere: (a) Layers. (b) Composition. (c) Global wind patterns. (d) Ozone.
- (5) Pressure: (a) Units of measure. (b) Weather systems characteristics. (c) Temperature effects on pressure. (d) Altimeters. (e) Pressure gradient force. (f) Pressure pattern flying weather.
- (6) Wind: (a) Major wind systems and Coriolis force. (b) Jetstreams and their characteristics. (c) Local wind and related terms.
- (7) States of matter: (a) Solids, liquid, and gases. (b) Causes of change of state.
- (8) Clouds: (a) Composition, formation, and dissipation. (b) Types and associated precipitation. (c) Use of cloud knowledge in forecasting.



# Initial certification: Meteorology - Basic Weather Studies

(9) Fog: (a) Causes, formation, and dissipation. (b) Types.

**(10) Ice: (a) Causes, formation, and dissipation. (b) Types.**

(11) Stability/Instability: (a) Temperature lapse rate, convection. (b) Adiabatic processes. (c) Lifting processes. (d) Divergence. (e) Convergence.

(12) Turbulence: (a) Jetstream associated. (b) Pressure pattern recognition. (c) Low level windshear. (d) Mountain waves. (e) Thunderstorms. (f) Clear air turbulence.

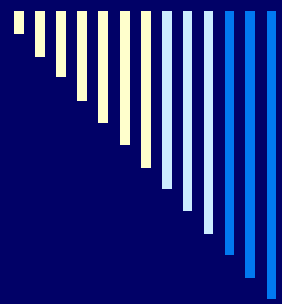
(13) Airmasses: (a) Classification and characteristics.

(b) Source regions. (c) Use of airmass knowledge in forecasting.

(14) Fronts: (a) Structure and characteristics, both vertical and horizontal.

(b) Frontal types. (c) Frontal weather flying.

(15) Theory of storm systems: (a) Thunderstorms. (b) Tornadoes. (c) Hurricanes and typhoons. (d) Microbursts. (e) Causes, formation, and dissipation.



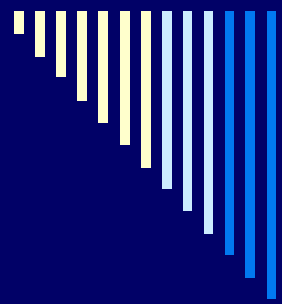
# Initial certification: Meteorology - Weather, Analysis, and Forecasts

## (1) Observations:

- (a) Surface observations.
- (b) Terminal forecasts.
- (c) Significant en route reports and forecasts.
- (d) Weather imagery.
- (e) Meteorological information data collection systems.

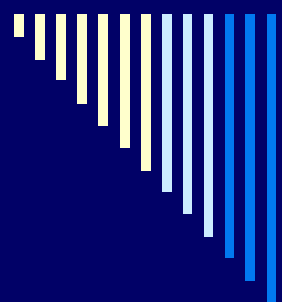
## (2) Data collection, analysis, and forecast facilities.

## (3) Service outlets providing aviation weather products.



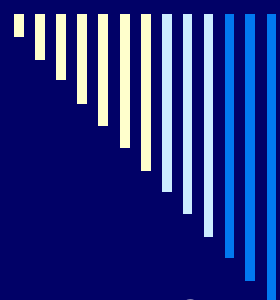
# Initial certification: Meteorology - Weather Related Aircraft Hazards

- (1) Crosswinds and Gusts.
- (2) Contaminated Runways.
- (3) Restrictions to Surface Visibility.
- (4) Turbulence and Windshear.
- (5) Icing.**
- (6) Thunderstorms and Microburst.
- (7) Volcanic Ash.



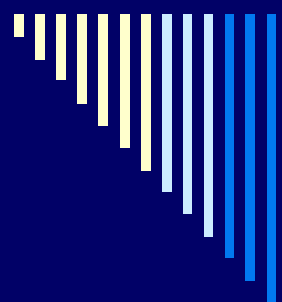
# New Hire Training

- Airline specific: Principal Operations Inspectors (POIs)
- For example, at one regional airline, the new hire training includes 136 hours
  - 40 hours is on company specific indoctrination
  - 96 hours
    - 73 modules
    - 14 contained subject matter related to icing



# New Hire Training: General subjects

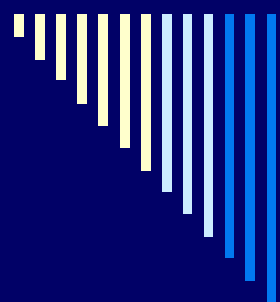
- ❑ Communications systems and normal and emergency procedures;
- ❑ **Meteorology, including various types of meteorological information and forecasts, interpretation of weather data (including forecasting of en route and terminal temperatures and other weather conditions), frontal systems, wind conditions, and use of actual and prognostic weather charts for various altitudes;**
- ❑ The NOTAM system;
- ❑ Navigational aids and publications;
- ❑ Joint dispatcher-pilot responsibilities;
- ❑ Characteristics of appropriate airports;
- ❑ **Prevailing weather phenomena and the available sources of weather information;**
- ❑ Air traffic control and instrument approach procedures; and
- ❑ Approved dispatcher resource management (DRM) initial training.



# New Hire Training: Aircraft specific

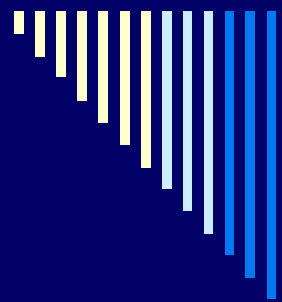
- ❑ Operating and performance characteristics, navigation equipment, instrument approach and communication equipment, emergency equipment and procedures, and other subjects having a bearing on dispatcher duties and responsibilities;
- ❑ Flight operation procedures
- ❑ Weight and balance computations;
- ❑ Basic airplane performance dispatch requirements and procedures;
- ❑ Flight planning including track selection, flight time analysis, and fuel requirements; and
- ❑ Emergency procedures.





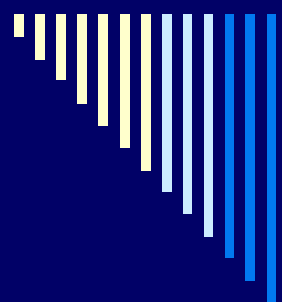
# Recurrent Training

- Required hours per year are limited (i.e., 20 hours or less)
- Airline specific: Principal Operations Inspectors (POIs)



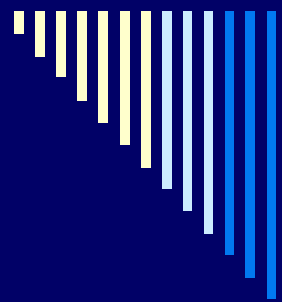
# Airline-specific Training Considerations

- Different training facilities
- Different fleet & flight routes
- Different tools & equipment
- Meteorology department
- Impact of assignment of flights



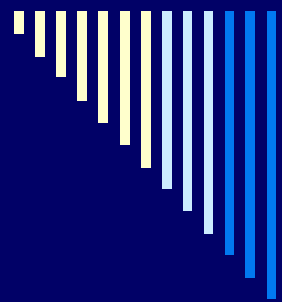
# Similarities in Airline Training Practices

- Basic training schedules
- Curricula for meteorological information
- Scenario-based approach
- Months of on the job mentoring



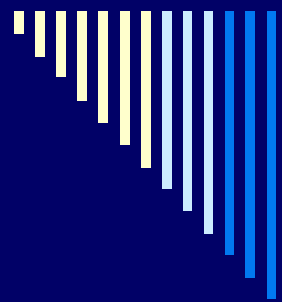
## Requirements to consider

- ❑ Integrate into instructor-led environment
- ❑ Include basic meteorological information on icing
- ❑ May need to allow tailoring in order to meet the needs of more airlines



# Goals for Analysis

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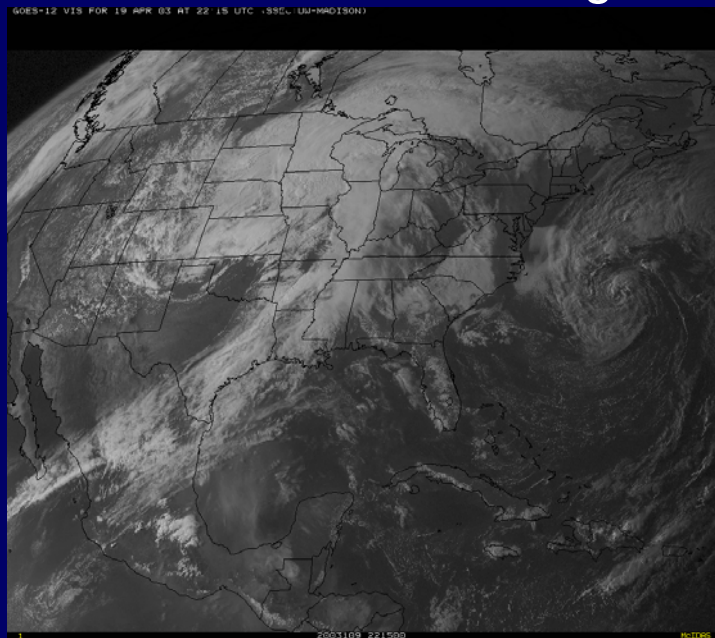


# Problems Interpreting Weather Products

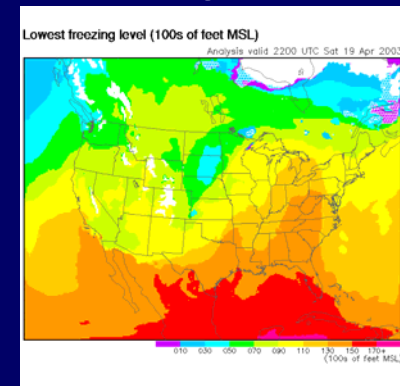
- Weather sources have different content and characteristics:
  - Different vendors
  - Different geographic regions
  - Different levels of precision
  - Representation: graphic vs. text based
  - Based on observations vs. forecast
    - Age of report
    - Update cycle
  - Forecasts
    - Different time frames
    - Uncertainty

# Content Example

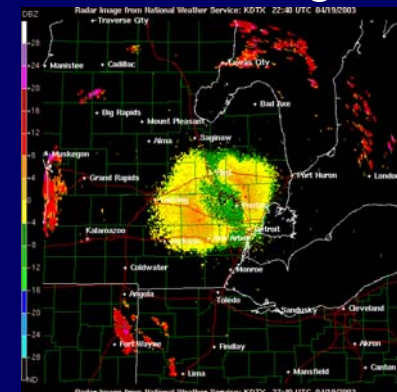
## Visible Satellite Image



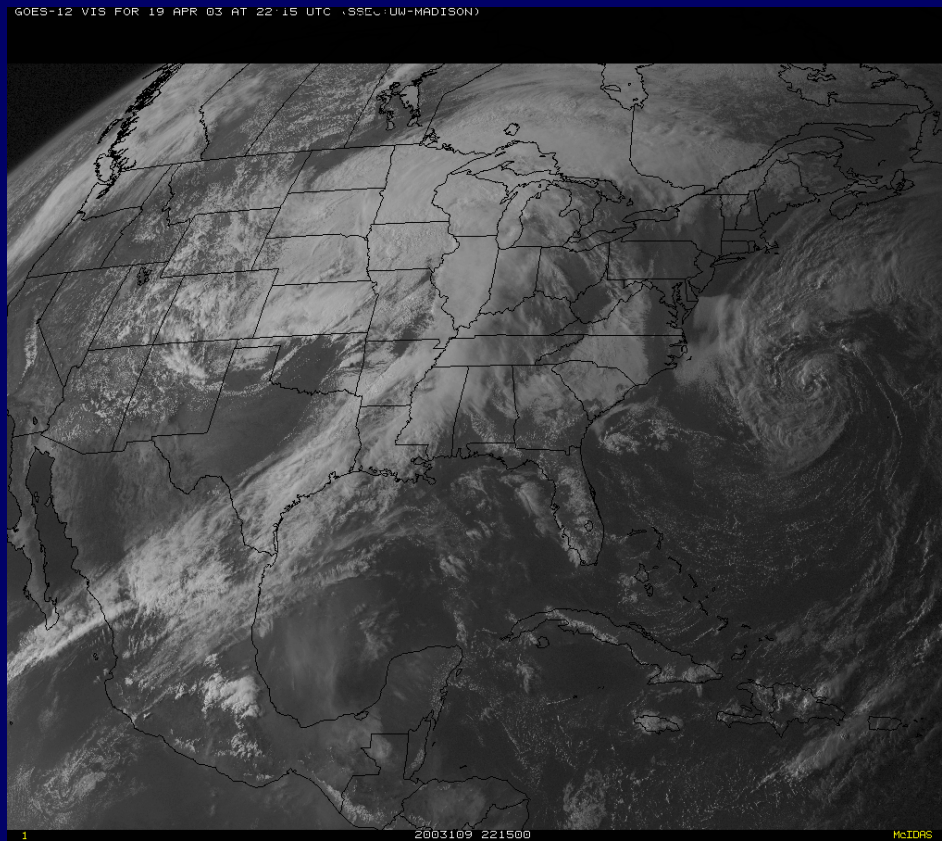
## Freezing Levels



## Radar Image



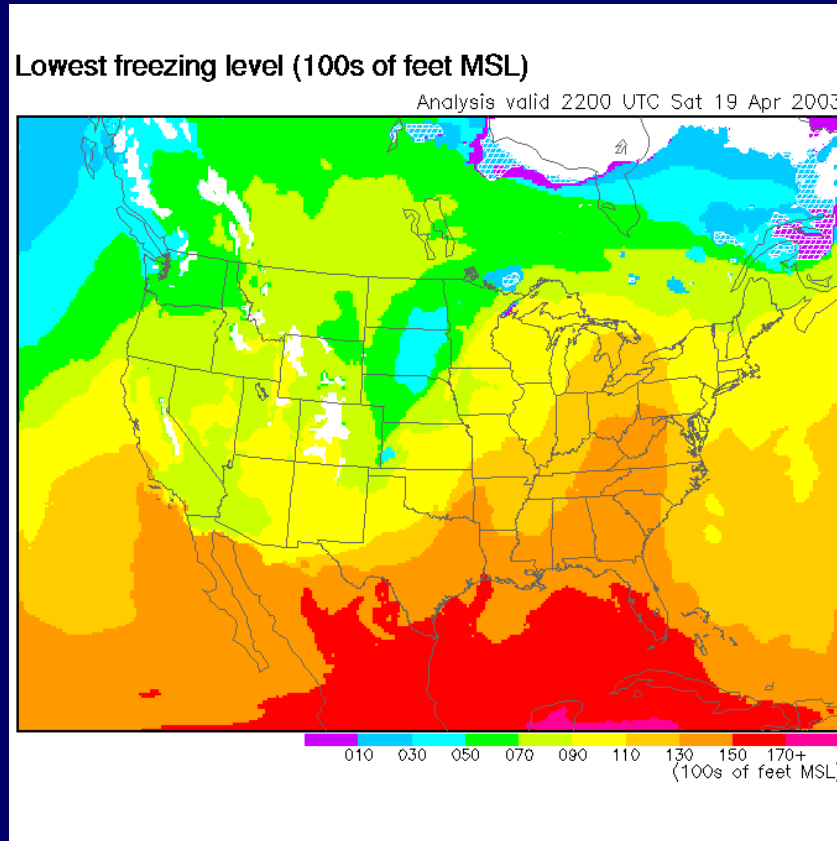
# Visible Satellite Image Example



This satellite image is used primarily to determine the presence of clouds as well as the cloud shape and texture. Only during daylight hours, and can be misinterpreted.

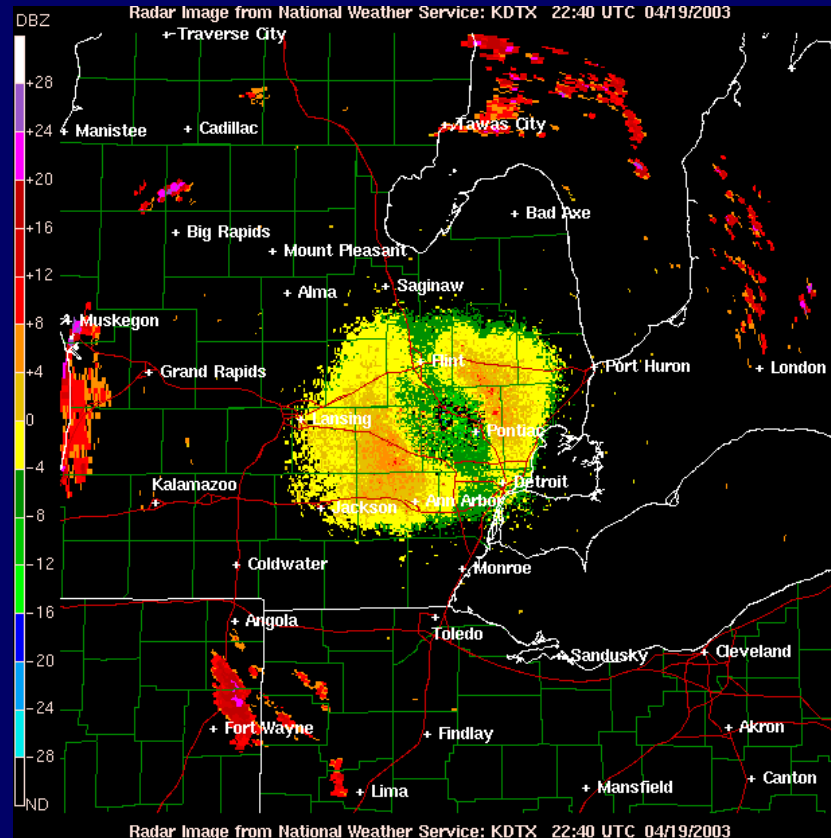


# Freezing Levels Example



Freezing level products contains forecasts for every three hours including the current forecast. They depict the altitude of the freezing level in feet for the entire country. This information must be integrated with the amount of moisture in the atmosphere.

# Radar Image Example

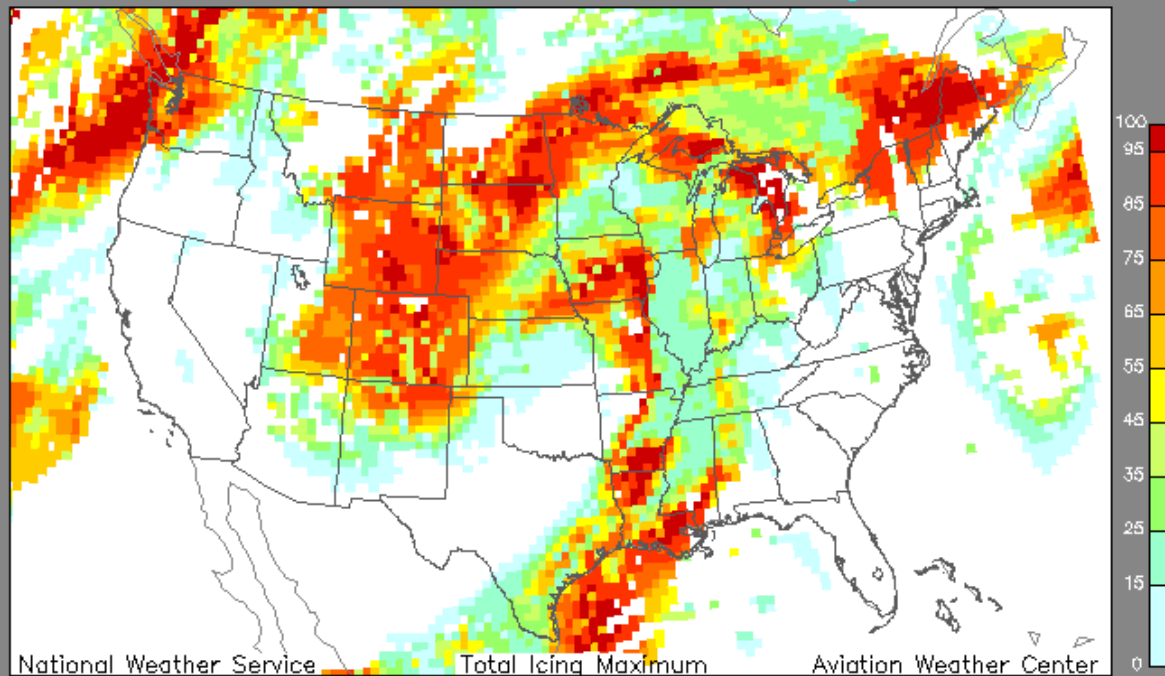


Identifies precipitation intensity and location— not icing. Shows hazardous thunderstorms, echo heights of tops and bases of precipitation areas. It does not detect all cloud formations such as fog. Actual cloud tops may be lower or higher than indicated. Also, targets get more inaccurate with distance from the antenna

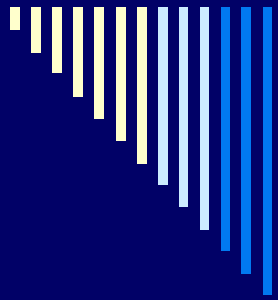
# Algorithm Example

VALID: Sat 19 Apr 2003 2200 UTC

Current Icing Potential

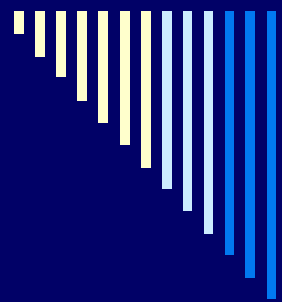


The CIP is an automatically-generated product that supplements AIRMETs and SIGMETs by identifying areas of current icing potential, but it does NOT substitute for the intensity and forecast information contained in AIRMETs and SIGMETs. It is authorized for operational use by meteorologists and dispatchers.



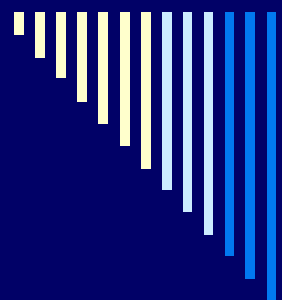
# METAR Example

- Aviation Routine Weather Report (METAR)
- KDEN 171953Z 17017G25KT 10SM FEW070  
SCT150 SCT200 19/01 A2977 RMK AO2  
PK WND 14027/1941 SLP037 T01890006



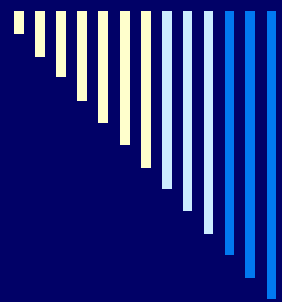
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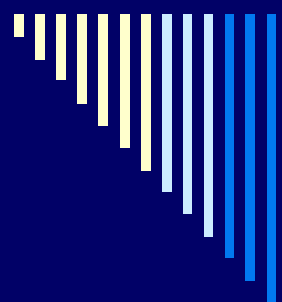
# Barriers

- New products have to “buy themselves into” the training environment
- Not all training facilities have a work station per trainee
- Flight dispatchers may not use it at home (may use as a resource OTJ)
- Discrepancies between company policies and web site
  - Instructor-led approach allows point out
- Lock step training can be too constraining
- POIs need guidance on use of distant-learning products
  - FAA (AFS-210) is investigating and will develop an Advisory Circular



# Goals for Analysis

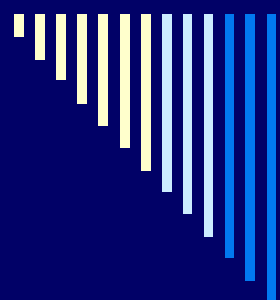
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# Key Components in a Web-based Icing Training System

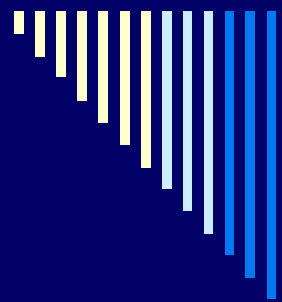
- ❑ Basic meteorological information
  - Materials exist and can be adapted
- ❑ Weather products information
  - Based on common tools: e.g., ADF web site
  - May need ability to add sources used at an airline
- ❑ Scenario related training
  - “Generic” aircraft and flight routes
  - May need ability to add scenarios specific to an airline
- ❑ Icing incident and accident review





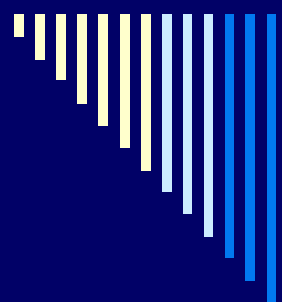
# Weather Products Information

- Focus on interpretation and integration of weather products
- How to use them to understand the weather conditions
- Use case studies



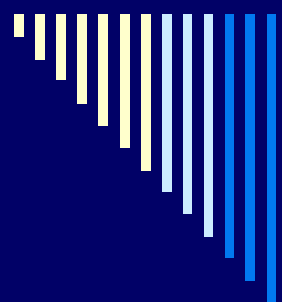
# Scenario Development

- Based on task inventory
  - Flight release
  - Weight & balance
    - Passengers, luggage, cargo, fuel, ...
  - Crew assignment
  - Minimum Equipment Lists (MELs)
  - Alternate airport assignment
  - Contingency fuel



# Scenario Components

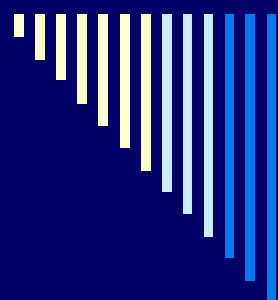
- Aircraft type
- Aircraft equipment status
- Flight route
- Weather conditions
- Selection of alternate airports
- Weight and balance
- Crew
- Consideration of downstream legs



# Icing-related Incidents and Accidents

Could be incorporated into a scenario

Could be presented in a separate section of the training system



# Prototype

Glossary Weblinks

## Tracking Legend

Not Viewed - ☐  
In-Progress - ☐  
Complete - ☒

# Flight Dispatcher Icing Training Tool

## Basic Meteorological Information

### Structural Icing

#### Types of Icing

#### Induction System Icing ✓

#### Instrument Icing

#### Other Factors

#### Ground Icing

#### Frost

## Icing Scenario

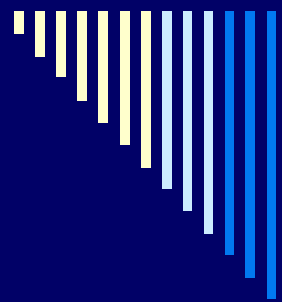
## Weather Sources

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## Structural Icing

Two conditions are necessary for structural icing in flight: the aircraft must be flying through visible moisture such as rain droplets or clouds, and the temperature at the point where the moisture strikes the aircraft must be 0C or colder. Aerodynamic cooling can lower temperature of an airfoil to 0C even though the ambient temperature is a few degrees warmer.

Supercooled water increases the rate of icing and is essential to rapid accumulation. Supercooled water is in an unstable liquid state; when an aircraft strikes a supercooled drop, part of the drop freezes instantaneously. The latent heat of fusion released by the freezing portion raises the temperature of the remaining portion to the melting point. Aerodynamic effects may cause the remaining portion to freeze. The way in which the remaining portion freezes determines the type of icing. The types of structural icing are clear, rime, and a mixture of the two. Each type has its identifying features.



# Recommendations for Future Efforts

- Address specific training objectives in concert with collaborating airlines
- Validate the component strategy with collaborating airlines using prototype
  - Populate prototype with generic and airline specific material
  - Usability study with instructors and operational FDs
  - Learning evaluation study
- Develop material access strategy to be user tailorable
- Develop material sharing capability